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Al-Be-Sc (Aluminum-Beryllium-Scandium)

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Recently, [2003Fri] determined an isothermal section for this ternary system at 600 °C in the Sc-lean region, which depicts no ternary phases.

Binary Systems

The Al-Be phase diagram [Massalski2] is of the simple eutectic type, with very little terminal solid solubility between Al and Be. The Al-Sc phase diagram [Massalski2] depicts the following intermediate compounds: $ScAl_3$ ($L1_2$ $AuCu_3$-type cubic), $ScAl_2$ ($C15$, $MgCu_2$-type cubic), ScAl ($B2$, CsCl-type cubic) and Sc_2Al ($B8_2$, Ni_2In-type hexagonal). Using 15 binary alloys, [2003Fri] determined the Be-Sc phase diagram. It depicts only the three known Be-Sc compounds: $ScBe_{13}$ ($D2_3$, $NaZn_{13}$-type cubic), Sc_2Be_{17} (Th_2Ni_{17}-type or Th_2Zn_{17}-type), and $ScBe_5$ ($D2_d$, $CaCu_5$-type hexagonal). The eutectic between (Be) and $ScBe_{13}$ is at 1280 °C and between 0.1 and 0.15 at.% Sc. $ScBe_{13}$ and $ScBe_5$ form congruently, whereas Sc_2Be_{17} forms through a peritectic reaction [2003Fri].

Ternary Phase Equilibria

With starting metals of 99.99% Al, 99.6% Be, and 99.6 or 99.975% Sc, [2003Fri] induction melted under Ar atm about 20 ternary alloys, containing up to 17.5 at.% Sc. The alloys were annealed at 600 °C for 800 h and quenched in water. The phase equilibria were studied by metallography, x-ray powder diffraction, electron probe microanalysis, differential thermal analysis and hardness measurements. The isothermal section at 600 °C for the Sc-lean region constructed by [2003Fri] is shown in Fig. 1. The region is characterized by the three-phase fields of (Be) + $ScBe_{13}$ + (Al), (Al) + $ScBe_{13}$ + $ScAl_3$, and $ScBe_{13}$ + Sc_2Be_{17} + $ScAl_3$. The solubility of the third component in the binary compounds is negligible. No ternary phases were found.

The partial results obtained by [2003Fri] on the solidification features indicate that the monovariant liquidus line originating from the eutectic point on the Be-Sc side slopes down towards the Be-Al side, as shown in Fig. 2.

Reference

2003Fri: I.N. Fridlyander and L.V. Molchanova, Interaction of Beryllium with Aluminum and Scandium, *Metally*, (5), p 109-114, in Russian; TR: *Russ. Metall.*, 2003, (5), p 476-480

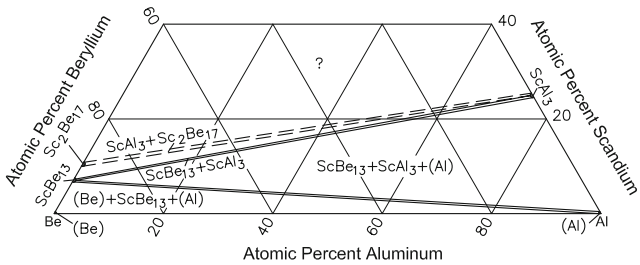

Fig. 1 Al-Be-Sc isothermal section at 600 °C for Sc-lean alloys [2003Fri]

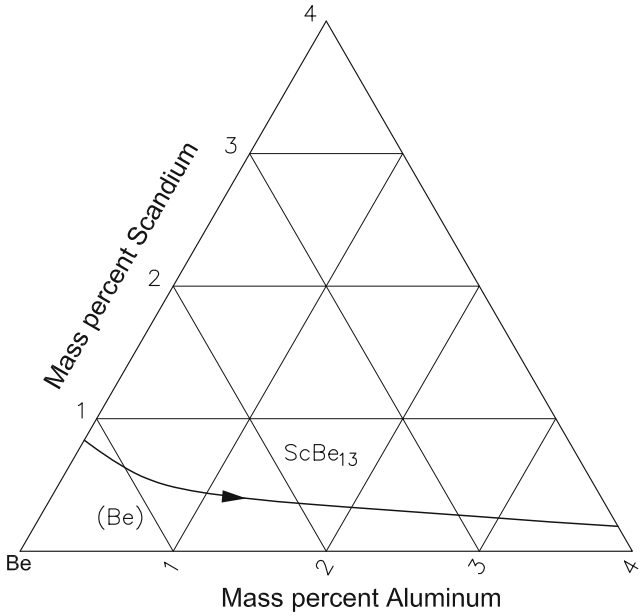

Fig. 2 Al-Be-Sc monovariant liquidus line for L + (Be) + $ScBe_{13}$ equilibrium [2003Fri]